Many regional climate models (RCM) and numerical weather prediction (NWP) models still use out-dated aerosol data sets to calculate the direct aerosol radiative forcing. We compare multi-year RCM simulations over Europe with COSMO-CLM under present-day conditions using different aerosol climatologies: a new climatology based on a simulation with a coupled aerosol microphysics module, the monthly mean climatology of Tegen et al. (1997) and the constant in time data set of Tanré et al. (1984). The latter is known to strongly overestimate aerosol optical depth (AOD) over the European continent. We show that the new climatology with a more realistic pattern of AOD leads to an increase of surface solar net radiation by more than 20% in the Mediterranean region, causing an annual mean 2m-temperature increase of about 0.8K in this area. Despite the temperature increase above land surfaces, we find that the new climatology yields colder temperatures in the mid-troposphere due to a drastic reduction of the short-wave absorption by desert dust. This reduced solar heating cools and thus destabilizes the atmosphere relative to the simulation with the climatology of Tanré, enhancing cloud formation and precipitation. In some regions of Europe, precipitation increases by more than 30% due to the use of a more appropriate aerosol climatology. Similar results are obtained with the Tegen-climatology. Therefore, we suggest that the RCM community uses updated aerosol information for radiative transfer calculations.